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IN THE MATTER OF
International Patent Application
No. PCT/EP97/05222
In the Name of Braun Aktiengesellschaft

DECLARATION

I, Birgit Hubatsch, of Elisabethenstr. 33a, D-64390 Erzhausen, Federal Republic of Germany, do hereby declare that I am conversant with the English and German languages and am a competent translator thereof, duly sworn for the Law Courts and Public Notaries of Hessen/Germany.

I also declare that to the best of my knowledge and belief the accompanying document is a true and correct translation made by me of the description, the claims and the abstract as originally filed, of pages 1 to 3 as amended, and of the claims 1 to 11 as amended, of International Patent Application No. PCT/EP97/05222 published in the German language.

∠ FIRATLI et al. GERMAN DE 196 40 852 is priority case of this

Signed this 16th day of February 1999

BIRGIT HUBATSCH ★ 64390 ERZHAUSEN ★
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Bristle for a Toothbrush

This invention relates to a bristle for a toothbrush, in particular for an electric toothbrush, which is comprised of a monofilament made of plastic.

Bristles of this type are generally known and are used, for example, in electrically powered toothbrushes.

It is an object of the present invention to further develop such bristles, in particular with a view to achieving an improved cleaning effect when cleaning teeth.

This object is accomplished in a bristle of the type initially referred to in that the monofilament is of a non-circular cross-section, is twisted about its longitudinal axis, and is fixed as a result of the action of chemical agents.

A three-dimensionally structured surface is created by the non-circular cross-section and the twisting of the monofilament. Since an important role in dental cleaning is played not only by the bristle tip but also by the bristle shell surface, the bristle constructed in accordance with the present invention has a greater cleaning effect than hitherto. In particular, the structured surface is in a position to remove plaque from the tooth surface substantially better.

The twist and hence the structured surface of the monofilament are set permanently by fixing with the aid of chemical agents. During this process, the orientation conditions of the molecular chains in the filament material remain practically unchanged. Relocations occur in the edge layers only. This results in greater strength and rigidity of the bristle for the same diameter than with other fixing methods. As a result of the type of fixing used, it is possible to use monofilaments with particularly small diameters, which are then significantly

better able to penetrate in particular interproximal spaces for the removal of plaque. The cleaning effect of the bristle according to the invention is thus substantially improved on the whole.

In an advantageous further configuration of the bristle of the present invention, the cross-section of the monofilament is approximately symmetrical to a plane extending parallel to the longitudinal axis. It has proven to be particularly suitable for the cross-section of the monofilament to be of an approximately stellate configuration. A particularly good three-dimensionally structured surface of the bristle is formed by these further configurations. In particular, this results in a helically structured bristle surface.

Diameters in the range from 0.1016 mm (4 mils), approximately, to 0.254 mm (10 mils), approximately, have proven to be particularly advantageous for the envelope curve of the monofilament, particularly in connection with the use of the bristle of the present invention in an electric toothbrush. Further, it is advantageous for the monofilament to have twists numbering from 0.5 to 2 per mm, approximately, in the direction of the longitudinal axis, and for the monofilament to be made of polyamide, polyester and/or polypropylene.

In an advantageous method of manufacturing a bristle according to the present invention, the monofilament is twisted and then fixed as a result of the action of chemical agents. In this manner, the twist is retained permanently, while the mechanical properties of the monofilament are substantially preserved. Edges and corners are rounded off by the partial chemical dissolving of the monofilament, and the resulting transitions are clean particularly from the point of view of hygiene. Further, the fixing referred to represents a simple and highly controllable way of processing the twisted monofilament and of

manufacturing therefrom the bristle according to the present invention with the described surface structure.

In an advantageous further configuration of the method of the present invention, the monofilament is twisted at one point, and at the same time twisting is prevented or curbed at a distance from this particular point. In this manner, a helical three-dimensional structure is produced on the surface of the bristle. Further, this structure includes additional edges and radii, which have an advantageous effect in general in dental cleaning and which are particularly suitable for removing plaque from the tooth surface or from out of interproximal spaces.

In an advantageous further configuration of the method of the present invention, the filaments are fixed in the solvent for a period of between 5 s and 50 s, approximately, preferably between 20 s and 30 s, approximately. Formic acid has proven to be a particularly appropriate solvent for filaments made of polyamide.

In a particularly advantageous further configuration of the invention, the bristles of the invention are used in the inner field of a preferably electrically powered round-head toothbrush.

Further features, advantages and application possibilities of the present invention will become apparent from the subsequent description of embodiments illustrated in more detail in the accompanying drawings. It will be understood that any single feature and any combination of single features described and/or represented by illustration form the subject-matter of the present invention, irrespective of their summary in the claims and their back reference. In the drawings,

FIGS. 1a and 1b are a schematic view and a cross-sectional view of a toothbrush bristle, illustrating an embodiment of the present invention; and

FIG. 2 is a schematic view of alternative cross-sections of the bristle of FIG. 1.

FIGS. 1a and 1b show a bristle 1 which is comprised of a monofilament 2. The monofilament 2 is made of plastic and is twisted. The twist is executed uniformly, which means that the surface structure of the bristle 1 is repeated continuously. The bristle 1 thus has a structured surface which the monofilament 2 does not possess initially, but which is not created until the monofilament 2 is twisted.

The monofilament 2 shown in FIGS. 1a and 1b may be made of polyamide, polyester, or polypropylene. The diameter of the envelope curve of the monofilament 2 referred to may amount to between 0.1016 mm (4 mils) and 0.254 mm (10 mils), approximately. The monofilament 2 may have twists numbering from 0.5 per mm to 2.0 per mm, approximately, in the direction of its longitudinal axis.

The monofilament 2 has a non-circular cross-section. This cross-section is of a stellate configuration in accordance with FIG. 1b and hence is approximately symmetrical to a plane extending parallel to the longitudinal axis. A helical three-dimensional structure, identified by reference numeral 3 in FIG. 1a, is obtained by the non-circular cross-section and the twisting of the monofilament 2.

It is also possible for the cross-section of the monofilament 2 to adopt any one of the alternative shapes as illustrated in FIG. 2.

To manufacture the bristle 1, the monofilament 2 is twisted. For this purpose, the monofilament 2 is twisted at one point while at the same time it is held fixed at a distance from this particular point, thus preventing or at least curbing a twist. It is possible to perform the twisting of the monofilament 2 with prior stretched filaments which already have the required mechanical properties.

The twisted monofilament 2 is then dipped in a solvent where it is fixed by partial chemical dissolving. The dwell time in the solvent amounts to a period of between 5 s and 50 s, approximately. Phenol, M-cresol or formic acid may be used as solvents. Highly concentrated formic acid has proven to be particularly advantageous. In this case the monofilament is conveniently wetted with the solvent for a period of between 20 s and 30 s, approximately. By dipping or wetting the monofilament 2 in or with the solvent, the twisting is fixed. This means that the monofilament 2 does not untwist again but that the twist remains permanently.

During or after the fixing it is possible to vary the mechanical properties, in particular the rigidity, the fatigue and/or the resilience of the monofilament 2, by stretching and/or by means of a thermal treatment.

The monofilament 2 is then cleaned of the solvent by rinsing with water or the like, or the solvent is neutralized by some other means, for example, by evaporation. The monofilament 2 is then dried by radiated heat or the like.

The described bristle 1 of FIGS. 1a and 1b is intended for use in toothbrushes, particularly for use in electric toothbrushes. The described bristle 1 may be used particularly advantageously in the inner field of a round-head tooth brush.

Patent Claims

1. A bristle (1) for a toothbrush, in particular for an electric toothbrush, which is comprised of a monofilament (2) made of plastic, **characterized in that** the monofilament (2) is of a non-circular cross-section, is twisted about its longitudinal axis, and is fixed as a result of the action of chemical agents.

2. The bristle (1) as claimed in patent claim 1, **characterized in that** the cross-section of the monofilament (2) is approximately symmetrical to a plane extending parallel to the longitudinal axis.

3. The bristle (1) as claimed in any one of the patent claims 1 or 2, **characterized in that** the cross-section of the monofilament (2) is of an approximately stellate configuration.

4. The bristle (1) as claimed in any one of the patent claims 1 to 3, **characterized in that** the diameter of the envelope curve of the monofilament (2) is in the range from 0.1016 mm (4 mils), approximately, to 0.254 mm (10 mils), approximately.

5. The bristle (1) as claimed in any one of the patent claims 1 to 4, **characterized in that** the monofilament (2) has twists numbering from 0.5 to 2 per mm, approximately, in the direction of the longitudinal axis.

6. The bristle (1) as claimed in any one of the patent claims 1 to 5, **characterized in that** the monofilament (2) is made of polyamide, polyester and/or polypropylene.

7. A method of manufacturing a bristle (1) as claimed in any one of the patent claims 1 to 6, **characterized in that** the monofilament (2) is twisted and then fixed as a result of the action of chemical agents.

8. The method as claimed in patent claim 7, **characterized in that** the monofilament (2) is twisted at one point, and at the same time twisting is prevented or curbed at a distance from this particular point.

9. The method as claimed in any one of the patent claims 7 or 8, **characterized in that** the monofilament (2) is fixed in the solvent for a period of between 5 s and 50 s, approximately, preferably between 20 s and 30 s, approximately.

10. The method as claimed in any one of the patent claims 7 to 9, **characterized in that** phenol, M-cresol and/or formic acid are used as solvents.

11. The use of the bristle (1) as claimed in any one of the patent claims 1 to 6 in the inner field of a preferably electrically powered round-head toothbrush.

Abstract of the Disclosure

The invention is directed to a bristle (1) for a toothbrush, in particular for an electric toothbrush, which is comprised of a monofilament (2) made of plastic. The monofilament (2) is of a non-circular cross-section, is twisted about its longitudinal axis, and is fixed as a result of the action of chemical agents. In this manner, the bristle (1) is provided with a three-dimensionally structured surface which effects an improved cleaning action, in particular with regard to the removal of plaque.

(FIG. 1)

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Exhibit 5

Bristle for a Toothbrush

This invention relates to a toothbrush filament which is comprised of a monofilament made of plastic.

Filaments of this type are generally known and are used, for example, in electrically powered toothbrushes.

From DE-AS 1 140 901 a plastic bristle for cleaning brushes for domestic and industrial use is known, which bristle is profiled in cross section and helically wound.

It is an object of the present invention to further develop a toothbrush filament, in particular with a view to achieving an improved cleaning effect when cleaning teeth.

This object is accomplished in the toothbrush filament of the type initially referred to in that the monofilament is of a non-circular cross-section, is twisted about its longitudinal axis, and the resultant structured helical surface is fixed by partial chemical dissolving of the edge layer of the monofilament, whereby the shape of the helical surface is retained permanently.

A three-dimensionally structured surface is created by the non-circular cross-section and the twisting of the monofilament. Since an important role in dental cleaning is played not only by the bristle tip but also by the bristle shell surface, the bristle constructed in accordance with the present invention has a greater cleaning effect than hitherto. In particular, the structured surface is in a position to remove plaque from the tooth surface substantially better.

The twist and hence the structured surface of the monofilament are set permanently by fixing with the aid of chemical agents. During this process, the orientation conditions of the molecular chains in the filament material remain practically

unchanged. Relocations occur in the edge layers only. This results in greater strength and rigidity of the bristle for the same diameter than with other fixing methods. As a result of the type of fixing used, it is possible to use monofilaments with particularly small diameters, which are then significantly better able to penetrate in particular interproximal spaces for the removal of plaque. The cleaning effect of the bristle according to the invention is thus substantially improved on the whole.

In an advantageous further configuration of the toothbrush filament of the present invention, the cross-section of the monofilament is approximately symmetrical to a plane extending parallel to the longitudinal axis. It has proven to be particularly suitable for the cross-section of the monofilament to be of an approximately stellate configuration. A particularly good three-dimensionally structured surface of the bristle is formed by these further configurations. In particular, this results in a helically structured bristle surface.

Diameters in the range from 0.1016 mm (4 mils), approximately, to 0.254 mm (10 mils), approximately, have proven to be particularly advantageous for the envelope curve of the monofilament, particularly in connection with the use of the toothbrush filament of the present invention in an electric toothbrush. Further, it is advantageous for the monofilament to have twists numbering from 0.5 to 2 per mm, approximately, in the direction of the longitudinal axis, and for the monofilament to be made of polyamide, polyester and/or polypropylene.

In an advantageous method of manufacturing a bristle according to the present invention, the monofilament is twisted and the resultant structured helical surface is subsequently fixed by partial chemical dissolving of the edge layer of the monofilament, whereby the shape of the helical surface is

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retained permanently. In this manner, the twist is retained permanently, while the mechanical properties of the monofilament are substantially preserved. Edges and corners are rounded off by the partial chemical dissolving of the monofilament, and the resulting transitions are clean particularly from the point of view of hygiene. Further, the fixing referred to represents a simple and highly controllable way of processing the twisted monofilament and of manufacturing therefrom the bristle according to the present invention with the described surface structure.

In an advantageous further configuration of the method of the present invention, the monofilament is twisted at one point, and at the same time twisting is prevented or curbed at a distance from this particular point. In this manner, a helical three-dimensional structure is produced on the surface of the bristle. Further, this structure includes additional edges and radii, which have an advantageous effect in general in dental cleaning and which are particularly suitable for removing plaque from the tooth surface or from out of interproximal spaces.

In an advantageous further configuration of the method of the present invention, the filaments are fixed in the solvent for a period of between 5 s and 50 s, approximately, preferably between 20 s and 30 s, approximately. Formic acid has proven to be a particularly appropriate solvent for filaments made of polyamide.

In a particularly advantageous further configuration of the invention, the toothbrush filaments of the present invention are used in the inner field of a preferably electrically powered round-head toothbrush.

Further features, advantages and application possibilities of the present invention will become apparent from the subsequent description of embodiments illustrated in more detail in the accompanying drawings. It will be understood that any single feature and any combination of single features described and/or represented by illustration form the subject-matter of the present invention, irrespective of their summary in the claims and their back reference. In the drawings,

Patent Claims

1. A toothbrush filament which is comprised of a monofilament (2) made of plastic, **characterized in that** the monofilament (2) is of a non-circular cross-section, is twisted about its longitudinal axis, and the resultant structured helical surface is fixed by partial chemical dissolving of the edge layer of the monofilament (2), whereby the shape of the helical surface is retained permanently.

2. The toothbrush filament (1) as claimed in patent claim 1, **characterized in that** the cross-section of the monofilament (2) is approximately symmetrical to a plane extending parallel to the longitudinal axis.

3. The toothbrush filament (1) as claimed in any one of the patent claims 1 or 2, **characterized in that** the cross-section of the monofilament (2) is of an approximately stellate configuration.

4. The toothbrush filament (1) as claimed in any one of the patent claims 1 to 3, **characterized in that** the diameter of the envelope curve of the monofilament (2) is in the range from 0.1016 mm (4 mils), approximately, to 0.254 mm (10 mils), approximately.

5. The toothbrush filament (1) as claimed in any one of the patent claims 1 to 4, **characterized in that** the monofilament (2) has twists numbering from 0.5 to 2 per mm, approximately, in the direction of the longitudinal axis.

6. The toothbrush filament (1) as claimed in any one of the patent claims 1 to 5, **characterized in that** the monofilament (2) is made of polyamide, polyester and/or polypropylene.

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7. A method of manufacturing a toothbrush filament (1) as claimed in any one of the patent claims 1 to 6, **characterized by** the steps of twisting the monofilament (2) and subsequently fixing the resultant structured helical surface by partial chemical dissolving of the edge layer of the monofilament (2), whereby the shape of the helical surface is retained permanently.

8. The method as claimed in patent claim 7, **characterized in that** the monofilament (2) is twisted at one point, and at the same time twisting is prevented or curbed at a distance from this particular point.

9. The method as claimed in any one of the patent claims 7 or 8, **characterized in that** the monofilament (2) is fixed in the solvent for a period of between 5 s and 50 s, approximately, preferably between 20 s and 30 s, approximately.

10. The method as claimed in any one of the patent claims 7 to 9, **characterized in that** phenol, M-cresol and/or formic acid are used as solvents.

11. The use of the toothbrush filament (1) as claimed in any one of the patent claims 1 to 6 in the inner field of a preferably electrically powered round-head toothbrush.

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